

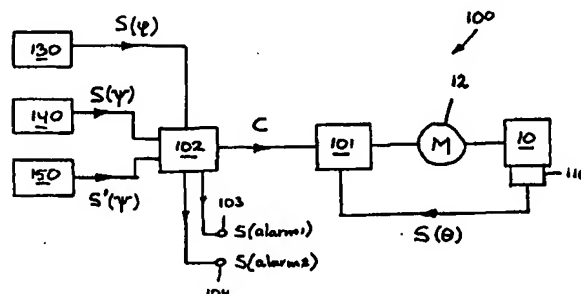
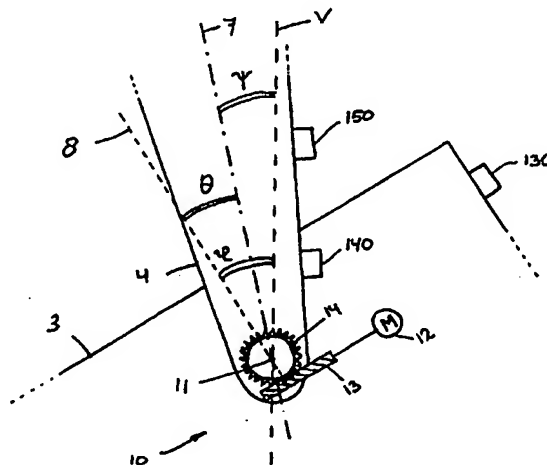


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup> :</b>  <b>B66B 9/08</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 99/29611</b>  <b>(43) International Publication Date:</b> 17 June 1999 (17.06.99)
<b>(21) International Application Number:</b> PCT/NL98/00709  <b>(22) International Filing Date:</b> 10 December 1998 (10.12.98)  <b>(30) Priority Data:</b> 1007770 11 December 1997 (11.12.97) NL  <b>(71) Applicant (for all designated States except US):</b> THYSSEN DE REUS B.V. [NL/NL]; Van Utrechtweg 99, NL-2921 LN Krimpen aan den IJssel (NL).  <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> KASBERGEN, Paulus [NL/NL]; Goudenregenstraat 56, NL-2906 CM Capelle aan den IJssel (NL). HEIJNS, Willem [NL/NL]; Van Hogendorpweg 43, NL-2953 BN Alblasserdam (NL). DUYNSTEE, Eduard, Jozef, Marie [NL/NL]; Dorpstraat 27, NL-2935 AB Ouderkerk aan den IJssel (NL).  <b>(74) Agent:</b> OTTEVANGERS, S., U.; Vereenigde Octrooibureaux, Nieuwe Parklaan 97, NL-2587 BN The Hague (NL).		<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i> <i>In English translation (filed in Dutch).</i>

**(54) Title:** STAIRLIFT**(57) Abstract**

There is described a stairlift (1), comprising: a carriage (3) displaceable along a bent path, and a chair (5) carried by said carriage (3) and mounted on said carriage (3) for tilting about a horizontal axis of rotation (11); a horizontal-keeping mechanism (100) for keeping the chair (5) upright, comprising: an angle sensor (110) providing a signal ( $S(\theta)$ ) indicative of the instantaneous value of an angle of rotation ( $\theta$ ) between the chair (5) and the carriage (3); an orientation sensor (130) associated with the carriage (3) and providing a signal indicative of variations in the position ( $\phi$ ) of the carriage (3); and an absolute-orientation sensor (140) associated with the chair (5), providing a signal ( $S(\psi)$ ) representative of the instantaneous value of the position ( $\psi$ ) of the chair (5). The control members (101, 102) control said angle of rotation ( $\theta$ ) on the basis of the signals ( $S(\phi)$ ,  $S(\psi)$ ) received.



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## STAIRLIFT

The present invention generally relates to a lift for transporting an object along a curved path, said object being held in a predetermined orientation. More in particular, the present invention relates to a stairlift, such as a chair  
5 stairlift or a wheelchair stairlift; and the present invention will hereinafter be specifically explained with reference to such practical example.

Hereinafter, the term "stairlift" will generally be used for a transport installation whereby, for instance,  
10 people who walk with difficulty and, consequently, are not capable of using the stairs, are enabled to ascend or descend that stairway as yet. Hence, a stairlift generally comprises a carriage and displacement means for displacing that carriage along the steps of a stairway. On that carriage, a  
15 chair can be mounted. A person sitting on that chair can ascend or descend the stairway in that the carriage moves up or down. During the path to be travelled, the orientation of the carriage varies in space. However, it will be understood that the chair must be held upright throughout the path, i.e.  
20 the sitting portion of the chair must be held substantially horizontal. Therefore, stairlifts of the above-mentioned type are provided with means for keeping the chair in a predetermined position relative to the vertical, which means will hereinafter be referred to as a 'horizontal-keeping  
25 mechanism'.

It will be understood by anyone skilled in the art that comparable requirements are imposed on, for instance, a wheelchair lift: in a wheelchair lift, a platform on which a wheelchair will rest must be held horizontal.

30 By way of example, reference is made to EP-0.436.103. This publication describes a carriage which, by means of caterpillar tracks, is capable of climbing the steps of a stairway or a different kind of slope. In particular at the beginning and at the end of the stairway, the incline of the  
35 carriage varies. On that carriage, a chair is mounted. In

accordance with a program inputted in a memory, the incline of the chair is controlled so that the center of gravity of the carriage is displaced to prevent the carriage from falling over.

5 Dutch patent 10.01327, to applicant, describes a stairlift comprising a guide rail that can be mounted along an existing stairway in, for instance, a house. A carriage can travel along that rail. Along the path of the stairway, the incline of the rail varies, and, accordingly, the  
10 orientation of the carriage varies in space. Mounted on that carriage is a chair which is to be held upright. However, this publication does not provide any details concerning the necessary horizontal-keeping mechanism.

Conventionally, the problem of keeping a chair upright  
15 when a carriage is to be displaced along a guide rail is solved in that along and parallel to said guide rail, a second rail, to be referred to as orienting rail, is provided, and the carriage comprises a lever coupled to the orienting rail, which lever operates a horizontal-keeping mechanism in a  
20 mechanical manner. The shape of the orienting rail is adapted to the shape of the guide rail so that in any position along the guide rail, the lever coupled to the orienting rail keeps the chair in upright position. A drawback of such conventional method, however, is that a second rail is  
25 required, whose shape is to be adjusted on the site of each individual installation.

To overcome this drawback, international patent application WO 95/18763 describes a stairlift whose horizontal-keeping mechanism comprises a tilting mechanism  
30 operable by an electric motor, and a control unit for the motor. The control unit comprises a memory storing a relationship between the position of the carriage along the rail on the one hand, and the desired orientation of the chair relative to the carriage on the other. The control unit  
35 obtains information concerning the current position along the rail, for instance by monitoring the revolutions of the

motor. On the basis of this position information, and on the basis of said relationship, the control unit sets a specific orientation of the chair relative to the carriage.

However, this installation, too, has the drawback that the information stored in the memory exclusively relates to a single, individual installation, while the relevant, memory-stored information is to be determined on the site, for which purpose the publication describes a programming session before the installation is put into operation. In this regard, it is a drawback that the memory has only a limited number of locations, so that the relationship is only defined for a limited number of positions along the rail and the position of the chair in intermediate positions must be determined by interpolation.

A further drawback is that the position of the chair is in each case set as a predetermined orientation relative to the carriage. However, it is not checked whether the chair is actually upright, as a result of which this known installation is not completely safe.

The object of the present invention is to provide a lift which does not have the above drawbacks.

More in particular, the object of the present invention is to provide a stairlift in respect of which, at least for the chair adjustment, it is not necessary to read in an electronic memory or adjust a mechanical memory at the location of the installation.

It is a further object of the present invention to provide a stairlift whose safety is increased, in that regardless of the position of the carriage and regardless of the orientation of the carriage, the orientation of the chair relative to the carriage can at all times be controlled so that the chair is upright in space.

To that end, in accordance with an important aspect of the present invention, the stairlift comprises a detector detecting changes in the absolute position of the carriage.

These and other aspect, characteristics and advantages of the present invention will be clarified by the following description of a preferred embodiment of a stairlift according to the invention, with reference to the

5 accompanying drawings. In these drawings:

Fig. 1 is a schematic side elevation of a portion of a stairlift construction;

Fig. 2 is a schematic side elevation of a stairway having a stairlift;

10 Fig. 3 schematically shows some details of a stairlift according to the present invention; and

Fig. 4 schematically shows a block diagram of a horizontal-keeping mechanism.

15 Fig. 1 schematically shows some parts of a stairlift 1 according to the present invention, generally denoted by reference numeral 1. The stairlift 1 comprises a rail 2 mounted along a stairway T (Fig. 2), for instance against a wall. A carriage 3 is displaceable along the rail 2, to which  
20 end the carriage 3 comprises a drive mechanism with a drive motor, not separately shown for the sake of simplicity. As the nature and construction of the rail 2 and the carriage 3 do not constitute a subject of the present invention, and a skilled person need not have any knowledge thereof for a  
25 proper understanding of the present invention, while, further, use can be made of constructions known per se, they will not be further described. By way of example, the rail may be provided with a gear rack and the motor operates a gear wheel engaging said gear rack, as described in  
30 WO 95/18763. Preferably, however, the rail has a circular cross section, and the drive mechanism has the construction as described in NL-10.01327.

Mounted on the carriage 3 is a chair support 4 carrying a chair 5. Via a rotation mechanism 10, shown only  
35 schematically, the chair support 4 is coupled to the carriage 3, which rotation mechanism 10 defines an axis of rotation 11

directed substantially horizontally, in Fig. 1 perpendicular to the plane of the drawing. By virtue of the rotation mechanism 10, the chair support 4 can rotate relative to the carriage 3 about said axis of rotation 11.

5       The rotation mechanism 10 can be any suitable mechanism, as will be understood by anyone skilled in the art, and will therefore not be further explained. It suffices to observe that the rotation mechanism 10 comprises an electromotor 12 for adjusting the support 4. For safety  
10 reasons, the rotation mechanism 10 is preferably self-braking, which means that in the event of failure of the motor 12, the chair 5 cannot fall over; in a possible embodiment, this characteristic feature is achieved in that the rotation mechanism 10 comprises a worm/wormwheel  
15 transmission 13/14 (see Fig. 3), as is known per se.

Fig. 2 illustrates a simple situation of a stairway T consisting of a number of steps. The stairway T can be a simple, straight stairway, in which case Fig. 2 can be regarded as a side elevation, but the stairway T can also  
20 have a horizontal bend (about a vertical axis), in which case Fig. 2 can be regarded as a horizontal projection on a vertical, curved plane. Fig. 2 clearly shows that the incline of the rail 2 varies along the length thereof: at the ends 21 and 22 the rail 2 is horizontal, at a central portion 23 the  
25 rail 2 has a constant incline, and at the transitional parts 24 and 25 the rail 2 is curved in vertical direction, i.e.; the rail 2 has a bend portion bent about a horizontal axis, with the incline of the rail changing continuously. In Fig. 1 it is sketched that the orientation of the carriage 3  
30 corresponds to the incline of the rail 2. In other words: when the carriage 3 moves along the rail 2, its orientation will change. The rotation mechanism 10 serves for setting an angle of rotation  $\theta$  of the chair support 4 relative to the carriage 3 in such a manner that the chair 5 is always kept  
35 upright in space, i.e. the seat 6 of the chair 5 is in each

case held substantially horizontal, regardless of the incline of the rail 2.

As described in the introduction, known systems require a reference to the fixed world for setting an angle of rotation of the chair support 4, such as, for instance, information concerning the instantaneous position along the rail 2.

Presently, a preferred embodiment of a horizontal-keeping mechanism 100 according to the present invention will be discussed with reference to Figs. 3 and 4. Fig. 3 schematically shows, to a larger scale than Fig. 1 for clarity's sake, a part of the carriage 3 and the chair support 4. In the following discussion, the chair support 4 is drawn with an exaggerated inclination, for the sake of illustration. A center line of the chair support 4 is designated by reference numeral 7; the absolute vertical is designated by V. The angle between the center line 7 and the vertical V is designated by  $\psi$ . In the ideal case, when the chair 5 is upright, i.e. the seat 6 is horizontal, at least symmetrical relative to the vertical V,  $\psi$  is  $0^\circ$ .

Reference numeral 8 designates a reference line associated with the carriage 3. This auxiliary line 8 is vertically directed when the carriage 3 is horizontally directed, i.e. when the carriage 3 is located entirely on a horizontal portion 21, 22 of the rail 2. When the carriage 3 is at an inclined portion 23, 24, 25 of the path 2, the carriage 3 is inclined over a specific angle, which angle is defined as the angle  $\phi$  between the reference line 8 and the vertical V.

The position of the chair support 4 relative to the carriage 3 is characterized by the angle  $\theta$  between the reference line 8 of the carriage 3 and the center line 7 of the chair support 4. When the chair 5 is upright and the carriage 3 is located entirely on a horizontal portion 21, 22 of the rail 2, this angle  $\theta$  equals  $0^\circ$ .



As appears from Fig. 3, in the example shown, it applies that  $\psi = \varphi - \theta$ .

The horizontal-keeping mechanism 100 comprises a first control member 101 which controls the exciting current I for the motor 12 in such a manner that a specific value of the angle of rotation  $\theta$  of the chair support 4 relative to the carriage 3 is kept constant. To that end, the horizontal-keeping mechanism 100 comprises an angle sensor 110 coupled between the chair support 4 and the carriage 3 for providing a signal  $S(\theta)$  to the first control member 101 which signal is indicative of the instantaneous value of the angle of rotation  $\theta$ .

The first control member 101 can for instance be a suitably programmed microprocessor or controller. In a simple embodiment, the first control member 101 can be a differential amplifier which receives the signal  $S(\theta)$  on its inverting input.

The angle sensor 110 can be any suitable sensor or transducer known per se. In a possible embodiment, this angle sensor 110 comprises an encoder coupled to a driven shaft of the rotation mechanism 10, which encoder can for instance be a segmented disk, as is known per se.

The horizontal-keeping mechanism 100 comprises a second control member 102, for instance a suitably programmed microprocessor or controller, providing a command signal C to the first control member 101. The first control member 101 controls the motor 12 on the basis of the command signal C. The command signal C can be directly indicative of a desired angle of rotation  $\theta$ ; in that case, the first control member 101 controls the motor 12 so that the measuring signal  $S(\theta)$  received from the angle sensor 110 corresponds to the command signal C. Alternatively, the command signal C can be indicative of a desired change  $\Delta\theta$  of that angle of rotation; in that case, the first control member 101 controls the motor 12 so that the command signal C becomes zero. Alternatively, the command signal C can be a ternary signal, representing

either the command "increase  $\theta$ ", or the command "decrease  $\theta$ ", or the command "maintain  $\theta$ "; in that case, the first control member 101 controls the motor 12 in accordance with the command received.

5 In accordance with an important feature of the present invention, the horizontal-keeping mechanism 100 comprises an orientation sensor 130 associated with the carriage 3. The orientation sensor 130 is sensitive to variations in the position of the carriage 3, i.e. variations in the angle  $\varphi$   
10 between the reference line 8 on the carriage 3 and the vertical V, measured in the plane perpendicular to the axis of rotation 11. The orientation sensor 130 can provide a signal  $S(\varphi)$  to the second control member 102 which signal is indicative of the instantaneous value of said angle  $\varphi$ . It is  
15 possible that the signal  $S(\varphi)$  in an absolute sense represents the value of  $\varphi$ , but that is not required: it is sufficient when  $S(\varphi)$  substantially has a constant value if  $\varphi$  does not vary. This means that that signal  $S(\varphi)$  represents the instantaneous value of said angle  $\varphi$  except for a constant  
20 value; this "constant value", however, need not be absolutely constant, but may slowly vary (drift) in time. The above implies that no strict requirements are imposed on the orientation sensor 130 in the sense of absolute accuracy; however, the orientation sensor 130 is required to react  
25 relatively quickly and accurately to changes of said angle  $\varphi$ .

The signal  $S(\varphi)$  from the orientation sensor 130 is provided as input signal to the second control member 102. The second control member 102 generates the command signal C for the first control member on the basis of the input signal  
30  $S(\varphi)$  received, in such a manner that  $\theta$  is changed equally yet opposite to a change of  $\varphi$ . The effect thus achieved is that the orientation of the chair 5 in space is kept constant upon variation of the orientation of the carriage 3.

As the operation and construction of the orientation  
35 sensor 130 do not constitute a subject of the present invention, and any knowledge thereof is not required for a

proper understanding of the present invention, this sensor will not be further discussed. It suffices to observe that such sensors are known per se, for instance in the form of a gyroscope, and that such sensors can be utilized.

5 In accordance with a further important feature of the present invention, the horizontal-keeping mechanism 100 comprises an absolute-orientation sensor 140 associated with the chair support 4. The orientation sensor 140 is sensitive to the rotational position of the chair support 4 relative to  
10 the axis of rotation 11, measured in the plane perpendicular to the axis of rotation 11. The absolute-orientation sensor 140 can provide a signal  $S(\psi)$  to the second control member 102, which signal is representative of the instantaneous absolute value of said angle  $\psi$ , which value represents the  
15 difference between the instantaneous rotational position of the chair 5 and the desired position (upright, i.e. horizontal seat 6). For this absolute-orientation sensor 140, accuracy is more important than speed.

The signal  $S(\psi)$  from the absolute-orientation sensor  
20 140 is provided as input signal to the second control member 102. The second control member 102 generates the command signal C for the first control member partly on the basis of the input signal  $S(\psi)$  received, in such a manner that  $\theta$  is changed to render  $\psi$  substantially equal to zero. The effect  
25 thus achieved is that the chair 5 is kept upright in space at all times.

As the operation and construction of the absolute-orientation sensor 140 do not constitute a subject of the present invention, and any knowledge thereof is not required  
30 for a proper understanding of the present invention, this sensor will not be further discussed. It suffices to observe that such sensors are known per se, for instance in the form of a gravitational direction sensor, and that such known sensors can be utilized.

35 The horizontal-keeping system 100 proposed by the present invention is thus capable, with a high degree of

certainty, to keep the chair 5 upright at all times, regardless of the position of the carriage 3, while speed and accuracy are combined. During normal use, a changing position of the carriage 3 will rapidly be detected on the basis of  
5 the signal  $S(\varphi)$ , and the position of the chair 5 relative to the carriage 3 is promptly adjusted to compensate for the changed position of the carriage 3. For an accurate control of the position of the chair 5 in absolute sense, the signal  $S(\psi)$  is used. With this signal, drift, if any, of the sensor  
10 130 is compensated for as well.

Preferably, the second control member 102 comprises two alarm outputs 103 and 104, and at those alarm outputs 103 and 104, the second control member 102 provides the alarm signal  $S(\text{alarm1})$  and  $S(\text{alarm2})$  if the control member 102  
15 detects specific predefined fault conditions. By way of example, the second control member 102 may be arranged to compare the signal  $S(\psi)$  with a first reference value representative of a first critical angle, and to generate at the first alarm output 103 the first alarm signal  $S(\text{alarm1})$   
20 if it is detected that the absolute value of  $\psi$  exceeds the first critical angle. That first critical angle may for instance be  $5^\circ$ . The first alarm signal  $S(\text{alarm1})$  is supplied to a control circuit, not shown for simplicity's sake, for the drive means of the carriage 3, to hold the carriage 3  
25 still as long as this situation lasts. Such a situation could for instance present itself if it cannot keep pace with a quick change of the position of the carriage 3; by holding the carriage still in that case, the horizontal-keeping system 100 is enabled to "catch up" with this quick change.

30 The second control member 102 may be arranged to compare the signal  $S(\psi)$  with a second reference value representative of a second critical angle which is less than the first critical angle, and to remove the first alarm signal  $S(\text{alarm1})$  if it is detected that the absolute value of  
35  $\psi$  falls below that second critical angle. That second critical angle may for instance be  $2^\circ$ .

Under normal conditions, the fault angle of the chair 5 is usually less than  $5^\circ$ . If, for whatever reason, the control system of the horizontal-keeping system 100 fails, it could happen that the chair 5 assumes such an oblique position that a user falls from the chair. It will be understood that such a situation must be avoided. Therefore, the system 100 is preferably arranged so that if the fault angle rises above a predetermined third critical angle, all electric excitation is switched off, i.e. the carriage 3 and the chair 5 are fixed. This third critical angle may for instance be  $10^\circ$ . To that end, the second control member 102 may be arranged for comparing the signal  $S(\psi)$  with a third reference value representative of the third critical angle, and for generating the first alarm signal  $S(\text{alarm1})$  at the first alarm output 103 and for generating the second alarm signal  $S(\text{alarm2})$  at the second alarm output 104 if it is detected that the absolute value of  $\psi$  exceeds the third critical angle. The second alarm signal  $S(\text{alarm2})$  is supplied to the control circuit for the chair motor 12 to also hold the chair 5 still as long as this situation lasts. Optionally, a sound signal may also be generated with the second alarm signal  $S(\text{alarm2})$  for calling for help.

The above-described horizontal-keeping mechanism 100 is secured against failure of the orientation sensor 130, in the sense that faulty measuring signals  $S(\phi)$  cannot lead to an unacceptable fault position of the chair, because the absolute position of the chair 5 is detected by the absolute-orientation sensor 140, enabling a correction. Conversely, a faulty measuring signal  $S(\psi)$  from the absolute-orientation sensor 140 cannot be detected and/or corrected by the orientation sensor 130. To secure the horizontal-keeping mechanism 100 against failure of the absolute-orientation sensor 140 as well, the chair 5 preferably comprises a second absolute-orientation sensor 150, whose operation may be identical to that of the first absolute-orientation sensor

140. The signal provided by the second absolute-orientation sensor 150 is indicated as  $S'(\psi)$ .

The second control member 102 is arranged to compare the two measuring signals  $S(\psi)$  and  $S'(\psi)$  with each other, and to generate the first alarm signal  $S(\text{alarm1})$  at the first alarm output 103 and to generate the second alarm signal  $S(\text{alarm2})$  at the second alarm output 104 if it is detected that the difference between the two signals is more than a predetermined threshold value, for instance  $2^\circ$ . As it is not possible to determine, on the basis of the data received, which of the signals received is correct and which is faulty, the entire system should be stopped, in view of safety.

Preferably, the first sensor 140 and the second sensor 150 are mutually different types. This reduces the probability that, if a specific failure occurs in one of those sensors, a comparable failure occurs in the other sensor.

It will be readily understood by anyone skilled in the art that the protective scope of the present invention as defined by the claims is not limited to the embodiments shown in the drawings and discussed, but that it is possible to alter or modify the embodiments shown of the stairlift according to the invention within the framework of the inventive concept. For instance, it is possible that the two control members 101 and 102 are combined into a single control member.

Further, it is possible that the orientation sensor 130 provides a signal  $S(\partial\phi/\partial t)$  indicative of the time derivative of the angle  $\phi$ , and that the second control member 102 generates the command signal  $C$  for the first control member on the basis of the input signal  $S(\partial\phi/\partial t)$  received.

Claims

1. A lift (1), for instance a stairlift, such as a chair stairlift or a wheelchair stairlift, comprising:  
a carriage (3) which is displaceable along a path (2) of which a projection on a vertical plane contains at least one  
5 bend (24, 25);  
a drive mechanism having a drive motor for displacing the carriage (3) along said path (2);  
an object (5) such as a chair or a platform, carried by said carriage (3) and mounted on said carriage (3) for tilting  
10 about a substantially horizontal axis of rotation (11);  
a horizontal-keeping mechanism (100) for holding the object (5) in a predetermined position relative to the vertical, said horizontal-keeping mechanism comprising:  
- a rotation mechanism (10), driven by a motor (12), for  
15 causing said object (5) to tilt relative to said carriage (3);  
- control members (101, 102) for said motor (12);  
- an angle sensor (110) coupled to the control members (101, 102) and providing a signal ( $S(\theta)$ ) indicative of the  
20 instantaneous value of an angle of rotation ( $\theta$ ) between the object (5) and the carriage (3);  
- an orientation sensor (130) coupled to the control members (101, 102) and associated with the carriage (3), providing a signal ( $S(\varphi)$ ;  $S(\partial\varphi/\partial t)$ ) indicative of variations  
25 in the position ( $\varphi$ ) of the carriage (3) in respect of said axis of rotation (11) relative to the vertical (V);  
- wherein the control members (101, 102) are arranged to drive the motor (12) so that said angle of rotation ( $\theta$ ) is changed to an equal extent but opposite to the variations in  
30 the position ( $\varphi$ ) of the carriage (3) detected by the orientation sensor (130).
2. A lift according to claim 1, wherein the horizontal-keeping mechanism (100) comprises an absolute-orientation

- sensor (140) coupled to the control members (101, 102) and associated with the object (5), providing a signal ( $S(\psi)$ ) representative of the instantaneous value of the position ( $\psi$ ) of the object (5) in respect of said axis of rotation (11) relative to the vertical (V); and wherein the control members (101, 102) are arranged to drive the motor (12) on the basis of the received signals ( $S(\phi)$ ,  $S(\psi)$ ) in such a manner that said position ( $\psi$ ) of the object (5) is held substantially equal to a desired position.
- 10 3. A lift according to claim 1 or 2, wherein the control members (101, 102) are arranged to generate a first alarm signal ( $S(\text{alarm1})$ ) if it is detected that said position ( $\psi$ ) of the object (5) exceeds a predetermined first critical angle.
- 15 4. A lift according to claim 3, wherein the control members (101, 102) are arranged to remove the first alarm signal ( $S(\text{alarm1})$ ) if it is detected that said position ( $\psi$ ) of the object (5) falls below a predetermined second critical angle, smaller than the first critical angle.
- 20 5. A lift according to claim 3 or 4, wherein the control members (101, 102) are coupled to said drive mechanism of the carriage (3) to prevent displacement of the carriage (3) as long as said first alarm signal ( $S(\text{alarm1})$ ) is being generated.
- 25 6. A lift according to any one of claims 3-5, wherein the control members (101, 102) are arranged to fix the carriage (3) and the chair (5) if it is detected that said position ( $\psi$ ) of the object (5) exceeds a predetermined third critical angle.
- 30 7. A lift according to any one of claims 2-6, wherein the horizontal-keeping mechanism (100) comprises a second absolute-orientation sensor (150) coupled to the control members (101, 102) and associated with the object (5), providing a second signal ( $S'(\psi)$ ) representative of the  
35 instantaneous value of the position ( $\psi$ ) of the object (5) in

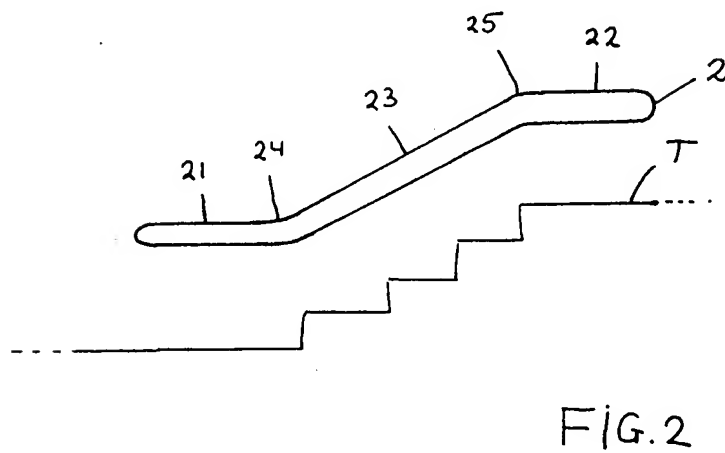
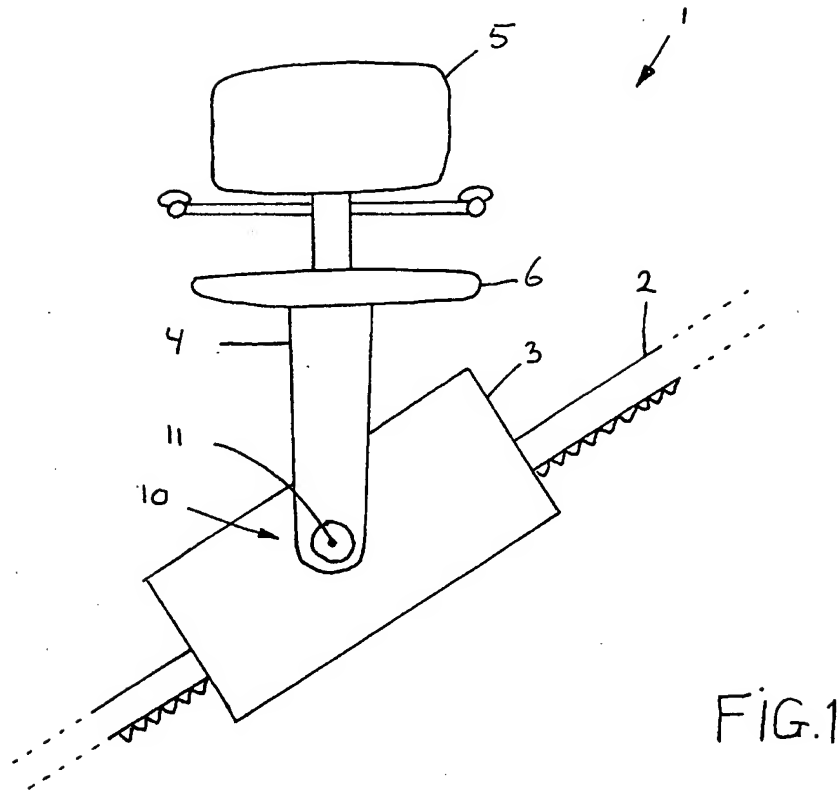


respect of said axis of rotation (11) relative to the vertical (V);

wherein the control members (101, 102) are arranged to compare the two signals ( $S(\psi)$  and  $S'(\psi)$ ) with each other;

- 5 and wherein the control members (101, 102) are arranged to fix the carriage (3) and the chair (5) if it is detected that a difference between said two signals ( $S(\psi)$  and  $S'(\psi)$ ), exceeds a predetermined threshold value.

8. A lift according to claim 7, wherein the two absolute-  
10 orientation sensors (140, 150) are of mutually different types.



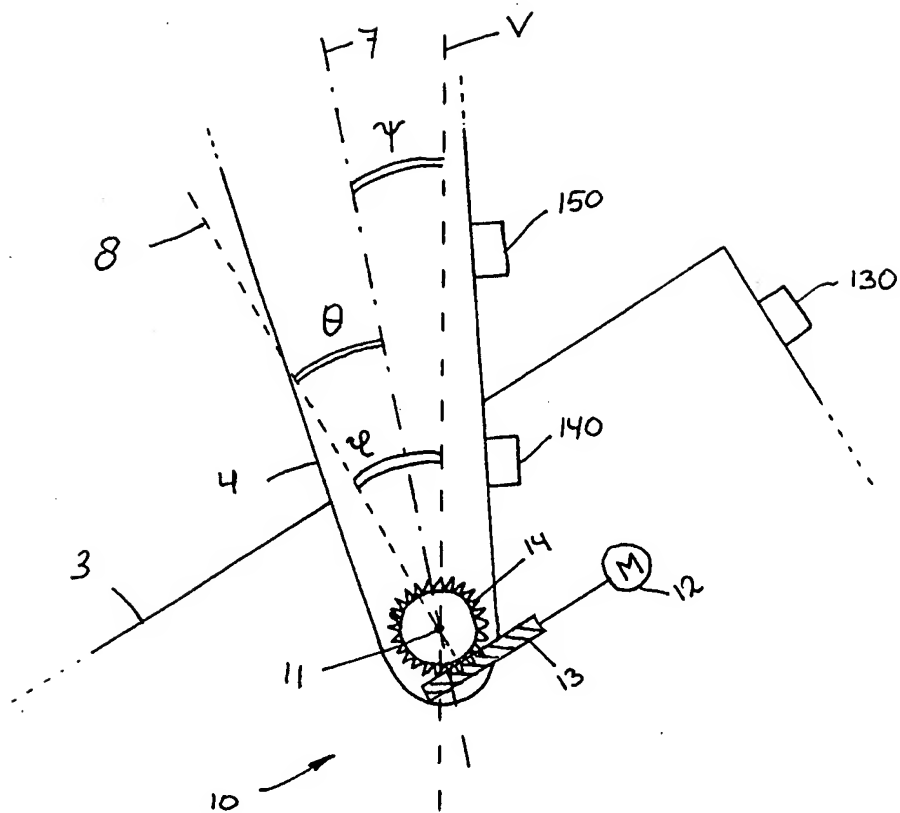


FIG. 3

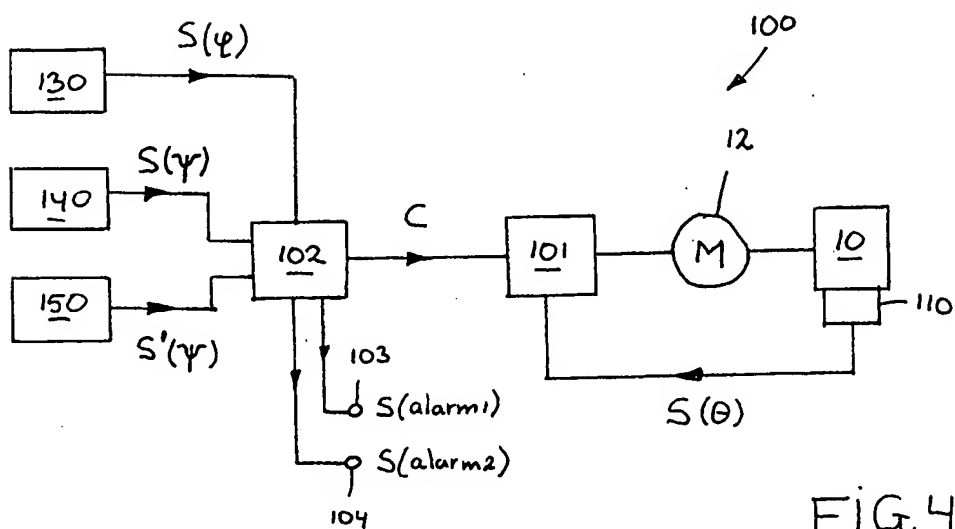


FIG. 4

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/NL 98/00709

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 6 B66B9/08

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B66B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 301 811 A (BISON BEDE LIMITED) 18 December 1996 see page 8 - page 9 ----	1,2
A	WO 95 18763 A (STANNAH STAIRLIFTS LTD ;GLOVER DOUGLAS WILLIAM (GB)) 13 July 1995 cited in the application see page 3, line 19 - line 25 ----	1-8
A	WO 95 29867 A (JOHANSSON BENGT) 9 November 1995 see page 6, paragraph 2; figures 1-4 -----	1,2



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

\* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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Date of the actual completion of the international search

19 March 1999

Date of mailing of the international search report

25/03/1999

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

Int'l Application No

PCT/NL 98/00709

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